Economic Feasibility of Growing Forage Biomass Crops in Iowa

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Introduction

Today's primary energy resources of oil, coal, and natural gas are non-renewable. Besides being exhaustible, there is growing consensus that environmental concerns about global warming, air pollution, and acid rain are caused by combusting these fossil fuels. Much research is now focused on developing alternative energy resources that are renewable, dependable, safe, and environmentally sound. One such alternative is energy from biomass crops. Biomass can be used to generate electricity either by direct burning or co-firing with coal. It also can be fermented to a liquid fuel such as ethanol. Several forage crops are leading candidates as biomass crops. Development of such energy crops would result in alternative uses for land and forage crops. Despite its renewability and environmental sustainability compared with fossil fuels, biomass has not been widely accepted as a primary energy source because of its relative high price. One of the most expensive aspects of biomass energy is the cost of producing the biomass crop. This study evaluated the cost of producing several biomass crops in Iowa to identify those that can be grown at the lowest price per ton of biomass.

Materials and Methods

Enterprise budgets were calculated for several crops and cropping systems based on yields from experimental plots grown for five years at two sites in Iowa. The first site is in central Iowa on a low erosive, highly productive soil having a Land Use Capability Classification of I. The second is in southern Iowa on a lower productive soil with a Land Use Capability Classification of III. Machinery costs were based on average Iowa equipment use. Alfalfa was assumed to receive adequate phosphorus and potash during establishment for the life of the stand. Other crops received annual applications of fertilizer.

Results and Discussion

Results for four of the crops studied are presented in Tables 1 and 2. For this comparison, alfalfa was harvested three times per year, reed canarygrass twice, and switchgrass and forage sorghum were harvested once per year. Sorghum had the lowest break-even price in both central and southern Iowa followed closely by switchgrass. Land cost is an important factor in production cost estimation. It accounted for more than 30% of all production costs. Land costs were higher in central Iowa than in southern Iowa because of the higher capability of the soil. Because of the lower land price in southern Iowa, the break-even price was generally lower in southern Iowa. The soils in southern Iowa were sloping and would result in serious soil erosion when an annual crop such as sorghum is grown.

Conclusions

Forage sorghum is the most suited crop for biomass production in central Iowa. Even though it was the cheapest to produce in southern Iowa, potential for soil erosion on these sloping soils would limit production there. In southern Iowa, switchgrass may be the most suitable for growing low cost biomass and still protect the soil from erosion because of its perennial nature and sod forming root system.

Table 1. Estimated annual production cost ($/acre) in central Iowa.

Item	Alfalfa	Reed canarygrass	Switchgrass	Forage sorghum
Yield (t/ac)	4.85	3.67	4.97	7.01
Direct expenses				
Phosphorus		8.00	8.00	14.50
Potash		15.98	15.98	7.99
Nitrogen		15.00	15.00	15.00
Herbicide	3.62			15.76
Seed				2.45
Operator labor	14.97	11.45	6.07	13.18
Fuel	7.42	5.82	3.10	8.45
Implements	14.24	10.71	5.52	10.59
Tractors	8.97	7.08	3.77	10.19
Interest	1.14	2.58	2.36	2.60
Transportation	20.13	15.23	20.63	29.09
Total	70.50	91.85	80.43	129.81
Fixed expenses				
Implements	15.38	12.21	6.38	19.97
Tractors	15.92	12.57	6.69	18.09
Land	115.00	115.00	115.00	115.00
Total	146.30	139.78	128.07	153.06
Establishment cost (prorated)	65.89	15.92	5.63	
Total expenses	282.69	247.55	214.13	282.87
Break-even price ($/ton)	58.29	67.45	43.08	40.35

Table 2. Estimated annual production cost ($/acre) in southern Iowa.

Item	Alfalfa	Reed canarygrass	Switchgrass	Forage sorghum
Yield (t/ac)	3.99	4.34	4.61	7.41
Direct expense				
Phosphorus		8.00	8.00	14.50
Potash		15.98	15.98	7.99
Nitrogen		15.00	15.00	15.00
Herbicide	3.62			15.76
Seed				2.45
Operator labor	14.97	11.45	6.07	13.18
Fuel	7.42	5.82	3.10	8.45
Implements	14.24	10.71	5.52	10.59
Tractors	8.97	7.08	3.77	10.19
Interest	1.10	2.60	2.36	2.61
Transportation	16.56	18.01	19.13	30.75
Total	66.89	94.65	78.93	131.47
Fixed expenses				
Implements	15.38	12.21	6.38	19.97
Tractors	15.92	12.57	6.69	18.09
Land	80.00	80.00	80.00	80.00
Total	111.30	104.78	93.07	118.06
Establishment cost (prorated)	62.07	12.34	8.04	
Total expenses	240.26	211.77	180.04	249.53
Break-even price ($/ton)	60.22	48.79	39.05	33.67